

## Momentum Fit and its Uncertainty

- Primary Goal : Understand errors of fit for final tracks
- Method :
  - 1 - Generate Monte Carlo muons at fixed momenta (5, 10, 20, 50, 100, 200 GeV/c )
  - 2 - Use standard track finder/fitting to get coordinate data
  - 3 - Fit data with MINUIT ; numerically computed error matrix
  - 4 - Add contribution of scattering to error

For each MC set at fixed momentum, can extract:

1. parameters of (kink) fit from MINUIT
  - 1.1 slopes and positions, up and downstream of magnet
  - 1.2 estimates of the errors for each parameter
2. momentum distribution
  - 2.1 mean momentum
  - 2.2 std dev (p)
  - 2.3 mean  $1/p$
  - 2.4 std dev  $1/p$
3. computed errors
  - 3.1 from fit
  - 3.2 from multiple scattering (not from MINUIT)
  - 3.3 total error

Standard form of momentum error:

$$\delta\left(\frac{1}{p}\right) \cong \sqrt{\left(\frac{\delta\vartheta_{MS}}{p_T^{mag} \cdot p}\right)^2 + (\delta\vartheta_{meas})^2} = \sqrt{\left(\frac{0.019}{p^2}\right)^2 + 1.6 \times 10^{-5}}$$

This is the same form found in Patrick's thesis. The values inserted into the equation for scattering are appropriate for Station 1. The  $p_T$  - kick used is 0.227 GeV/c.

The Table on the following page gives the measurements from the data, as well as the estimated errors from the above formula.

Note that the measurement errors in  $1/p$  are almost identical for all momenta and was computed to be 0.0034. Patrick's value is 0.0043. I tweaked the computed value to 0.0040, which matches this (MC) data slightly better.

A full write-up of this study is forthcoming.

$p$ GeV/c	$\mu_p$	$\sigma_{dist}$	$\chi^2$	$\sigma(p^{-1})_{dist}$	$\delta(p^{-1})_{dist}$	$\delta(p^{-1})_{est}$	$\delta(p^{-1})_{MS}$	$\delta(p^{-1})_{TOT}$
5	5.08	0.69	1.09	0.028	0.0034	0.0040	0.028	0.028
10	10.11	1.13	0.69	0.018	0.0034	0.0040	0.014	0.015
10*	10.20	0.90	0.57	0.013	0.0034	0.0040	0.008	0.009
20	20.8	2.5	0.52	0.012	0.0034	0.0040	0.0069	0.0080
50	48.4	7.4	0.53	0.0035	0.0034	0.0040	0.0028	0.0049
100	103.	21.	0.49	0.0041	0.0034	0.0040	0.0014	0.0042
200	213.	75.**	0.51	0.0036	0.0034	0.0040	0.0007	0.0041

Table of values from the data with estimated errors.

Note that columns 2-5 are derived from distributions at each momenta. Column 6 is the estimate of the measurement error from MINUIT and columns 7-9 are numbers recommended for the estimate of the total error in  $1/p$ . The figure of merit is the difference between column 5 and 9 for each row.